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ABSTRACTS FROM ASTRONOMICAL PUBLICATIONS.

In accordance with a recent arrangement the members of the scientific staff of the Lick Observatory hold meetings once per week, as an observatory duty, to report upon and discuss the more important articles appearing in the journals of astronomy, the important new books on astronomical subjects, or subjects of current and special interest in the observatory's work. It has been suggested that abstracts of the reports would be of interest to the readers of these Publications, and the Publication Committee has acted favorably upon the suggestion.

It is intended to preserve the qualities of abstracts as far as possible, and to restrict published criticisms, favorable or unfavorable, to a minimum.

A STATISTICAL INVESTIGATION OF COMETARY OBRITS, BY W. H. PICKERING.[1]

This exhaustive investigation, presented in a memoir of more than two hundred quarto pages, is based upon all available cometary orbits to the close of the year 1909. It is mainly devoted to a thorough analysis of the aphelion positions (in latitude and longitude) and distances, and to the possibility of deriving from these proof of the existence of undiscovered planets beyond the orbit of Neptune.

We speak familiarly of *Jupiter's* family of comets, referring to the thirty-four comets whose aphelia lie on or near *Jupiter's* orbit. Similarly, six comets are associated with *Neptune* and two each with *Saturn* and *Uranus*. It is generally assumed that these comets were "captured," or forced into their present orbits by the attractive power of these planets as the comets passed them in their journey in larger orbits around the Sun. Now, if the aphelia of all the periodic comets are plotted according to their distances, it will be found that there are points where they tend to cluster, besides those corresponding to the distance of our major planets. It is not a new idea that these points indicate the mean distances of undiscovered planets which have captured the comets involved. In particular, Professor G. FORBES, in 1878, predicted a trans-Neptunian planet on the basis of certain cometary orbits and gave the position in which the planet might be expected.

Professor PICKERING'S investigation, however, is by far the most complete that has been attempted, for he includes not only all of the periodic comets, but also those with computed parabolic and hyperbolic paths. He shows how a large (undiscovered) planet could, by its attraction, convert the path of an approaching comet from an ellipse to an hyperbola when near perihelion and reconvert it into an ellipse when it again recedes to a great distance.[1]

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[1] *Harvard College Observatory Annals*, Vol. LXI, Part III.

It would require too much space even to summarize the great amount of data which Professor PICKERING presents, much more to give a fair account of his extended computations and ingenious reasoning. The reader must consult the publication itself to form an opinion of the validity of his final results, and he will find the perusal not difficult and exceedingly interesting.

The conclusion is reached that, in addition to "Planet O," whose existence Professor PICKERING had predicted earlier from a study of the perturbations in the motion of *Neptune,* there are three undiscovered outer planets, which are designated as Planets P, Q, and R. The evidence for the existence of Planet Q is regarded as most conclusive. To this planet is assigned a mass 0.06 that of the Sun, or 20,000 times that of the Earth, a mean distance of 875 astronomical units and a period of 26,000 years. Its magnitude at present is given as 15.4 and its apparent angular diameter as 1″.6. To Planet R is assigned a mass half that of Q, a period of 500,000 years, and a stellar magnitude 26. Since the 60-inch reflector on Mount Wilson can only feebly photograph a star of the twenty-first magnitude in four hours time, it is obvious that there is no hope of verifying the predicted existence of Planet R. To Planet P is assigned a period of 1,400 years, with a mean distance of 123 units, only about four times that of *Neptune.* The mass and brightness of this planet are not given, but the predicted positions of both P and Q are stated.

In an appendix an account is given of a photographic search for Planet O. Although about 300,000 stars were examined on photographs of the region surrounding its predicted place, the planet was not discovered. The opinion is expressed that this is probably due to the fact that the planet may have been more than 10° north or south of the ecliptic, the limits that had been assumed in the search. R. G. AITKEN.

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[1] It may be remarked that he does not refer to the work of FABRY, FAYET, and STRÖMGREN, who, taking into account the *known* planets only, have shown that all known cometary orbits were doubtless originally ellipses. See these *Publications,* **23,** 124, 1911.

April, 1912.

STARS HAVING PECULIAR SPECTRA, BY WILLIAMINA P. FLEMING.[1]

The present number of the *Annals of Harvard College Observatory* has been read by astronomers with even greater interest than that which is always excited by these publications, not only because it is the last memoir prepared by the late Mrs. FLEMING, but especially because it contains in summary form so many of the results of her painstaking study and keen analysis of the Henry Draper Memorial photographs.

"A distinctive feature of the work of the Henry Draper Memorial has been the use of the objective prisms." Eight-inch photographic telescopes of the portrait lens type, equipped with such prisms, have been in use both at Cambridge and in Peru, and by their aid a library of nearly 80,000 photographs, on 8 x 10 plates, each covering a sky area about ten degrees square, has been accumuluated since 1885. The observing plan has been so arranged that the entire sky, from pole to pole, has been photographed several times each year, each set of plates recording the spectra of all of the stars sufficiently bright to affect the sensitive film. This material has been studied by Mrs. FLEMING and other members of the Harvard College Observatory staff, with results of the highest interest and importance. The vast majority of the recorded stellar spectra fall naturally into comparatively few well-defined classes—known, on the Harvard notation, as classes B, A, F, G, K, and M—or subdivisions of these classes. But there will be many exceptions, and it is these exceptions which form the subject of the present memoir.

The "peculiar spectra" have been collected in the form of thirteen tables, each of which is probably complete, to the limit of brightness set by the power of the telescope, since the entire sky has been covered several times in the study of the plates. These tables, in order, are:—

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[1] *Harvard College Observatory Annals,* Vol. LVI, No. VI.

Table	I.	New Stars, or Novæ.
"	II.	Gaseous Nebulæ. Spectrum P.
"	III.	Type V. Spectrum O.
"	IV.	Stars Having Bright Hydrogen Lines.
"	V.	Spectroscopic Binaries of Class A [both components bright].
"	VI.	Algol Variables. Class V.
"	VII.	Variables of the β *Lyræ* Class.
"	VIII.	Variables of Short Period. Class IV.
"	IX.	Variables of Long Period. Class II.
"	X.	Stars of Class N.
"	XI.	Stars Having Spectra of Class R.
"	XII.	Stars Having Spectra of Class Oe5.
"	XIII.	Stars Having Peculiar Spectra.

Table XIII contains twenty-nine objects which, at present, cannot be included in any of the other groups, and which have, in general, no characteristics in common. Each of the other twelve tables will be of the greatest service because of its completeness and its convenience for reference. The first table, for example, includes not only the Novæ found on the Draper Memorial plates, but also the earlier ones recorded since 1572.

It is significant of the importance of the work at Harvard College Observatory to note that fifteen of the nineteen (twenty, if we include *Nova Geminorum*, No. 2) Novæ that are known to have appeared since 1885 have been found there. Ten of these stand to Mrs. Fleming's credit. Again, of the 151 entries in Table II, all but thirty-four have either been found independently or confirmed by special examination of these plates. Ninety were discovered at Harvard, fifty-nine of them by Mrs. Fleming. In Table III, the so-called Wolf-Rayet stars, we have 107 entries. Thirteen of these were visual discoveries, the remaining ninety-four were detected on the Draper Memorial plates, mostly by Mrs. Fleming. In many of the other tables the debt we owe to the Draper Memorial is equally apparent.

R. G. Aitken.

May, 1912.

THE SPECTRUM OF COMET MOREHOUSE, BY A. FOWLER.[1]

The paper gives the results of a comparison of the tail bands found in MOREHOUSE'S Comet and those observed in the spectrum of carbon monoxide. Formulæ are also suggested which represent the observed positions of the lines much more accurately than do those of Messrs. PLUVINEL and BALDET.

SPECTROSCOPIC STUDIES OF HYDROGEN, BY HARVEY BRACE LEMON.[1]

The article presents the results of an effort on the part of the author to determine the effect of temperature on the emission of an electrically excited hydrogen tube. As is well known, the hydrogen spectrum consists of three spectra: 1. The series spectrum, to which the well-known solar lines C and F belong; 2. The so-called "compound" line spectrum, in which the lines are irregularly distributed; 3. Continuous spectrum.

The experiments consisted in preparing chemically pure hydrogen and observing the tube spectrum with the tube itself held at different temperatures. In the preparation of the gas great care was exercised to secure great purity and a very ingenious and effective mercury trap was devised to prevent contamination by mercury vapor from the pump. The measurements were made with a modified form of a Brace spectrophotometer. In measuring the brightness of the lines allowance was made for the continuous background on which they were superimposed. The author briefly sums up his conclusions in the following words:—

"It is concluded, therefore, that as regards the effect of temperature on the spectrum of hydrogen in a vacuum tube, excited by alternating current, (1) a variation in the temperature of the discharge tube of from 300° to 100° Abs. (Centigrade) largely affects the relative amounts of energy in the series and in the compound line spectrum, the latter being much enhanced at the lower temperature; (2) this variation of temperature does *not* affect the relative intensities of the series lines at least within the limits of error of the experiment, which have been guarded by a painstaking control of electrical conditions and careful photometric measurements."

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[1] *Astrophysical Journal,* **35,** 1912.

Such studies of the behavior of the spectra of gases, particularly of hydrogen, are of interest to the astronomer by reason of the light they shed on problems touching the constitution of celestial bodies. For instance, it has been held by some that the strength of the ultra violet members of the hydrogen series in the spectra of the gaseous nebulæ is an indication of high temperature in these bodies. Mr. LEMON'S results would seem to indicate that this peculiar distribution of intensity must be due to some other cause, such, for instance, as feeble intensity of excitation. A characteristic of nebular spectra is the freedom from the primary, or compound line spectrum of hydrogen. While this would be in harmony with the notion of a high temperature in the nebulæ, it must be confessed that at present our knowledge of the behavior of gases is not competent to settle the question. There are numerous other astrophysical problems that would be cleared up had we a complete knowledge of the behavior of the hydrogen spectrum under all conditions of excitation.

W. H. WRIGHT.

May, 1912.